

EMB190 Alerting Issues – Hydraulic failure (single system)

1. Initiating Condition: Complete fluid loss for the single most critical hydraulic system (2), in cruise flight

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Master caution blinking amber lights on L&R glareshield	Triggered by EICAS Caution Messages AUTOBRAKE FAIL and HYD 2 LO PRESS				Blinking terminates when the Master Caution light/pushbutton is pressed
	EICAS Caution Message (Amber, flashing, reverse video): AUTOBRAKE FAIL	Triggered by loss of hydraulic quantity	This is a consequence of the hydraulic system loss-- potentially confusing/misleading as it can precede the EICAS messages about the underlying hydraulic failure by several seconds		Inhibited from 80 knots up to 400 feet agl (takeoff)	Flashing/reverse video of the text ceases when the Master Caution light/pushbutton is pressed
	EICAS Advisory Message (Cyan, flashing/reverse video for 5 seconds): HYD 2 LO QTY				Inhibited from thrust lever advancement up to 80 knots (takeoff roll), 80 knots up to 400 feet agl (takeoff), and 200 feet agl down to 30 seconds after touchdown (landing)	Flashing/reverse video of the text ceases after 5 seconds
	EICAS Advisory Message (Cyan, flashing/reverse video for 5 seconds): BRK RH FAULT	Triggered by loss of hydraulic quantity	This is a consequence of the hydraulic system loss-- potentially confusing/misleading as it precedes the hydraulic EICAS messages		Inhibited from 80 knots up to 400 feet agl (takeoff)	Flashing/reverse video of the text ceases after 5 seconds

EMB190 Alerting Issues – Hydraulic failure (single system)

1. Initiating Condition: Complete fluid loss for the single most critical hydraulic system (2), in cruise flight – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	EICAS Advisory Message (Cyan, flashing/reverse video for 5 seconds): BRK LH FAULT	Triggered by loss of hydraulic quantity	This is a consequence of the hydraulic system loss-- potentially confusing/misleading as it precedes the hydraulic EICAS messages		Inhibited from 80 knots up to 400 feet agl (takeoff)	Flashing/reverse video of the text ceases after 5 seconds
	EICAS Caution Message (Amber, flashing, reverse video): >HYD 2 LO PRESS (">" denotes Root EICAS message)		This is a consequence of the quantity loss--but should not be confusing as it points to the same root cause and directs the pilots to the appropriate responses		Inhibited from 80 knots up to 400 feet agl (takeoff)	Flashing/reverse video of the text ceases when the master caution light/pushbutton is pressed
	EICAS Caution Message (Amber, flashing, reverse video): HYD PTU FAIL		This is a consequence of the quantity loss		Inhibited from 80 knots up to 400 feet agl (takeoff) and 200 feet agl down to 30 seconds after touchdown (landing)	Flashing/reverse video of the text ceases when the master caution light/pushbutton is pressed
	EICAS Caution Message SPOILER FAULT	Loss of Hydraulic System 2	This is a consequence of the hydraulic system loss	The Loss of Hydraulic System 2 directs the pilots not to accomplish the associated SPOILER FAULT procedure	Inhibited from thrust lever advancement up to 80 knots (takeoff roll), 80 knots up to 400 feet agl (takeoff), and 200 feet agl down to 30 seconds after touchdown (landing)	

EMB190 Alerting Issues – Hydraulic failure (single system)

1. Initiating Condition: Complete fluid loss for the single most critical hydraulic system (2), in cruise flight – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Aural Alerts	Single chime repeated every five seconds	Master caution				Repetition of chime terminates when master caution pushbutton is pressed
Tactile Alerts	None					
Visual Cues	On the MFD Hydraulic Synoptic Page, the digital quantity value and the analog quantity scale/pointer for the failed system turn cyan.			Pilot action is required to display the synoptic page on the MFD.		
	On the MFD Hydraulic Synoptic Page, the digital pressure value and the analog pressure scale/pointer for the failed system turn amber.			Pilot action is required to display the synoptic page on the MFD.		
	On the MFD Hydraulic Synoptic Page, the font size increases for the text inside the distribution box for the failed hydraulic system			Pilot action is required to display the synoptic page on the MFD.		
	On the MFD Hydraulic Synoptic Page, the schematic hydraulic line into the distribution box for the failed hydraulic system turns white.			Pilot action is required to display the synoptic page on the MFD.		
	On the MFD Hydraulic Synoptic page, low pressure and quantity readings on System 2 hydraulic system's digital readouts and analog gauges			Pilot action is required to display the synoptic page on the MFD.		

EMB190 Alerting Issues – Hydraulic failure (single system)

1. Initiating Condition: Complete fluid loss for the single most critical hydraulic system (2), in cruise flight – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Aural Cues	None					
Tactile/Somatic Cues	None					

Expected Pilot Response(s)

- Identify condition (low quantity followed by low pressure alerts/indications)
- Perform HYD 2 LO QTY procedure (no actions) followed by HYD 2 LO PRESS procedure, which internally calls for and leads into the Hydraulic System 2 Loss procedure
- Perform checklist
- As specified by the Hydraulic System 2 Loss procedure, identify follow-on requirements (PF assignment, landing distance requirement, alternate landing gear extension (included in the procedure), recommendations for coping with loss of nosewheel steering, commitment to destination once gear extended)
- Per the Loss of Hydraulic System 2 procedure, do not accomplish the SPOILER FAULT or LANDING GEAR ABNORMAL EXTENSION procedures
- Implement follow-on requirements (PF assignment, landing distance requirement, abnormal landing gear extension (included in the hydraulic procedure), recommendations for coping with loss of nosewheel steering, commitment to destination once gear extended) at the appropriate phase of flight

Possible sources of confusion with regard to pilot response(s)

- There may be a long time delay between the hydraulic failure and the implied procedures/actions, requiring the Hydraulic System 2 Loss procedure to be suspended and then resumed, and posing a prospective memory challenge (EICAS reminders about hydraulic status will continue to be displayed and are checked during subsequent flight phase normal checklists)

How does pilot know condition is resolved/recovered?

- Completion of procedures results in stable situation but abnormal condition for landing (e.g., longer landing distance); system cannot be recovered to normal operation.

Issues with regard to multiple concurrent non-normal conditions

- Simultaneous hydraulic and flight control system conditions
- Challenge of dealing with the concurrent and continuing failures resulting from the initiating condition (e.g., flaps, slats, autopilot, etc.)